Neutrino Energy Spectra from Nuclear Reactor Calculated from Nuclear Data Libraries

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Nuclear reactors generate a highly intense flux of electron-antineutrinos from fission-products through beta-minus decay, and a slight amount of electron-neutrinos through either beta-plus decay or electron capture. Neutrino energy spectra are usually calculated by the beta-decay theory. Since the reactor neutrinos are emitted from a great number of nuclides, the calculation requires a lot of level scheme of these nuclides. Nuclear data libraries, however, are available these days. It is possible to evaluate the electron-antineutrino and -neutrino spectra for a nuclear reactor on the basis of nuclear data libraries (JENDL-FP-Decay-Data-File-2000, JENDL-3.3). JENDL-FP-Decay-Data-File-2000 is a data library evaluated in Japan.The library contains the decay data of 1229 FP nuclides from A=60 to 178, and includes decay data of half-lives, decay modes, Q values, branching ratios and average energy values of such radiations as beta-rays, gamma-rays and alpha-rays. In addition, spectral data on individual radiations including conversion electrons and X-rays are separately given in the library. To compute neutrino spectra, we used the beta-rays spectra of this data library. Unlike the case of antineutrinos, electron-neutrinos often have monochromatic spectra caused by electron capture (E.C.). We calculated these spectra with the Q values of E.C. The main fissile nuclides to yield FPs in a reactor are U-235, U-238, Pu-239 and Pu-241. For FP yields of these nuclides, cumulative FP yield data for the thermal neutron (0.025eV) fission are selected in JENDL-3.3. These spectrum-data and yield-data enable us to readily compute the neutrino and antineutrino spectra from a reactor. In the study, we derive electron-neutrino and -antineutrino spectra in the energy range of 10 keV to 8 MeV from nuclear data libraries. The method gives good agreement with other studies for electron-antineutrino spectra. We show the simple method to estimate reactor neutrino spectra without complicated computation.

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